

## Module 14: Monitoring and Measurement

<b>Guidance .....</b>	<b>14-2</b>
<b>Tools and Forms .....</b>	<b>14-8</b>
<b>Tool 14-1:</b> Monitoring and Measurement Worksheet .....	14-8
<b>Tool 14-2:</b> EMS Program Measurement Criteria Worksheet .....	14-9
<b>Tool 14-3:</b> Sample Procedure for a Compliance Assessment .....	14-10
<b>Form 14-3:</b> Sample Form for Compliance Tracking .....	14-11
<b>Tool 14-4:</b> Pollution Prevention Tracking Log .....	14-12
<b>Tool 14-5:</b> Calibration Log.....	14-13
<b>Tool 14-6:</b> Environmental Performance Indicators Log.....	14-14
<b>Examples.....</b>	<b>14-15</b>
<b>Example 14-1:</b> Example of Links Between Aspects, Objectives and Targets, Operational Controls, and Monitoring and Measurement .....	14-15
<b>Example 14-2:</b> Linking Operational Controls and Monitoring.....	14-16



## ***GUIDANCE***

An EMS without effective monitoring and measurement processes is like driving at night without the headlights on — you know that you are moving but you can't tell where you are going! Monitoring and measurement help you:

- evaluate environmental performance;
- analyze root causes of problems;
- assess compliance with legal requirements;
- identify areas requiring corrective action, and,
- improve performance and increase efficiency.

In short, **monitoring and measurement helps you manage your organization better**. The results of pollution prevention and other efforts are easier to demonstrate when current and reliable data are available. These data can help you demonstrate the value of the EMS to top management.

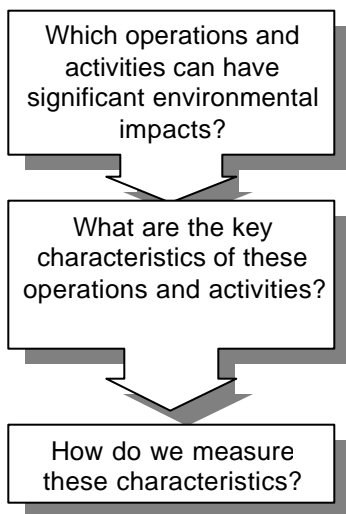
Your organization should develop means to:

- ✓ **Monitor key characteristics** of operations and activities that can have significant environmental impacts and/or compliance consequences;
- ✓ **Track performance** (including your progress in achieving objectives and targets);
- ✓ **Calibrate and maintain** monitoring equipment; and,
- ✓ Through internal audits, periodically **evaluate your compliance** with applicable laws and regulations.

An illustration of how monitoring and measurement is tied to the significant environmental aspects, objectives and targets, and operational controls of a hypothetical facility's EMS is presented in **Example 14-1**.

## Monitoring Key Characteristics

Many management theorists endorse the concept of the “**vital few**” — that is, that a limited number of factors can have a substantial impact on the outcome of a process. The key is to figure out what those factors are and how to measure them. Process mapping can help you determine what those factors might be (see *Module 3* for examples).



Most effective environmental monitoring and measurement systems use a combination of **process** and **outcome** measures.

- **Outcome measures** look at results of a process or activity, such as the amount of waste generated or the number of spills that took place.
- **Process measures** look at “upstream” factors, such as the amount of paint used per unit of product or the number of employees trained on a topic.

Select a combination of process and outcome measures that are right for your organization.

## Tracking Performance

To have a successful EMS, it is important to determine program measurement criteria. Determining measurement criteria, also called **performance indicators**, will help you evaluate the success of your overall EMS program. Performance indicators measure overall success, while key characteristic indicators measure progress against EMS objectives for specific SEAs. Examples of Performance Indicators are provided on the next page of this module.

The purpose of these indicators is different from the specific measurement criteria you developed for evaluating progress toward individual objectives. **These performance indicators focus on how well the overall system for improving environmental management is functioning.** Select performance indicators that will help you and your employees decide whether success has been achieved or whether improvement in procedures needs to be made. It is easier for management and staff to understand how things are going if they have benchmarks as guidelines.

You will need performance indicators that describe how well your environmental policy is being implemented. In addition, you will need performance indicators for all of the various components of your EMS. The measurement criteria selected for each component of your EMS will probably be different. For example, how will you measure the success of communication, documentation, stakeholder outreach, or training programs?

One approach is to measure the *actions*, for example, number of meetings held with stakeholders, number of documents created, number of employees trained, or number of hours of training. Action, however, does not always mean results. Consider the objective of each EMS component and define a way to measure *results* so that you would feel satisfied that the objectives are being achieved.

To measure results effectively, your methods should be:

- ☒ simple
- ☒ flexible
- ☒ consistent
- ☒ ongoing
- ☒ produce reliable data
- ☒ communicate results

**Tools 14-1 and 14-2** are worksheets that might help guide your facility in creating a thorough and effective monitoring and measurement element of your EMS.

Here are some examples of EMS results Performance Indicators for your EMS or various program components that can be tracked over time:

- number of SEAs included in environmental projects plan
- number of environmental objectives and targets met
- pounds of hazardous waste generated per unit of production
- employee sick leave absences related to work environment
- percentage of employees completing environmental training
- average time for resolving corrective action
- energy or water use per unit of production
- percentage of solid waste recycled/reused
- number of complaints from community; number of responses to complaints
- number of pollution prevention ideas generated from employees
- resources used per unit of product or service
- pollution (by type) generated per unit of product or service
- percentage of products for which life cycle assessment has been conducted
- number of products which have a recycling program
- number of instances of non-compliance

It is the results shown by these environmental performance indicators that will become the basis for your plans for next year and for documenting continuous improvement.

Measuring pollution prevention achievements is part of tracking performance, but may be different from, and often more difficult than, measuring environmental achievements in general. Simply measuring the reduction in a waste stream might mean only that the waste has been transferred to another medium, not reduced. It is therefore important to measure the reduction at the source of waste generation. It may also be important to measure the activities that your company directs towards pollution prevention. The following sources of information may help you track pollution prevention:

- Permit applications
- TRI reports
- Purchasing records
- Utility bills
- Hazardous waste manifests
- Material Safety Data Sheets

In addition, administrative procedures can be established to support pollution prevention activities. Your facility should consider:

- Establishing procedures in each facility area for identifying pollution prevention opportunities.
- Having a chemical or raw material inventory system in place.
- Assessing how many objectives have been met through pollution prevention.

## Calibrating Equipment

A component of monitoring and measurement is **equipment calibration**. Your facility should identify process equipment and activities that affect your environmental performance. As a starting point, look at those **key process characteristics** you identified earlier. For monitoring and measurement you can: (1) measure the equipment itself (for example, measuring the paint flow rate through a flow gun to see if it is within the optimal range for transfer efficiency) or you can (2) add measurement equipment to a process to help measure the key characteristic (for example, a thermometer on a plating bath to make sure that the temperature is within the optimal range for plating quality to reduce the need for replating which causes significant waste through product rework).

Some organizations place critical monitoring equipment under a special calibration and preventive maintenance program. This can help to ensure accurate monitoring and make employees aware of which instruments are most critical for environmental monitoring purposes. Some organizations find it is more cost-effective to subcontract calibration and maintenance of monitoring equipment than to perform these functions internally.

An illustration of how calibration needs are tied to SEAs, operational controls, key characteristics of the operation, and monitoring and measurement methods is presented in **Example 14-2**.

## Getting Started

- Monitoring and measuring can be a resource-intensive effort. One of the most important steps you can take is to clearly **define your needs**. While collecting meaningful information is clearly important, resist the urge to collect data “for data’s sake.”
- Review the kinds of monitoring you do now for **regulatory compliance** and other purposes (such as quality or health and safety management). How well might this serve your EMS purposes? What additional monitoring or measuring might be needed?
- You can **start** with a **relatively simple** monitoring and measurement process, then build on it as you gain experience with your EMS. It’s better to measure less items consistently, than to measure many items inconsistently.

## Hints

- **Regulatory compliance:** Determining your compliance status on a regular basis is very important. You should have a procedure to systematically **identify, correct, and prevent** violations. Effectiveness of the compliance assessment process should be considered during EMS **management review**. The EPA encourages “systematic discovery” of regulatory violations, which means detecting potential violations through environmental audits or compliance management systems that show due diligence in preventing, detecting, and correcting violations. EPA has prepared guidance documents

and protocols for conducting environmental compliance audits under a number of its regulatory programs. For more information, check the EPA web site at [www.epa.gov/oeca/index.html](http://www.epa.gov/oeca/index.html).

- **Operational performance:** Consider what information you will need to determine whether the company is implementing operational controls as intended.
- **Progress on meeting objectives:** You should measure progress on achieving objectives and targets on a regular basis and communicate the results of such measurement to top management. To measure progress in meeting objectives, select appropriate measurements of the key characteristics which apply to that objective.
- **Selecting performance indicators:** Performance indicators can help you to understand how well your EMS is working overall. Start by identifying a few performance indicators that are:
  - **simple** and understandable;
  - **objective**;
  - **measurable**; and
  - **relevant** to what your organization is trying to achieve (i.e., its objectives and targets)

Data collected on performance indicators can be quite helpful during **management reviews** (see *Module 18*). So, select indicators that will provide top management with the information it needs to make decisions about the EMS.

Make sure you can commit the necessary **resources** to track performance information over time. It is OK to **start small** and build over time as you gain experience in evaluating your performance. Keep in mind that **no single measurement** will tell your organization how it is doing in the environmental area.

- **Communicating performance:** People respond best to information that is meaningful to “their world.” Putting environmental information in a form that is **relevant to their function** increases the likelihood they will act on the information. Be sure to link your measurement program with your **communications** program and other elements of the EMS (such as management reviews, as discussed later).

**Tool 14-3** is sample procedure that your facility can adopt for assuring environmental regulatory compliance. **Form 14-3** is an example of a compliance tracking form to be used in association with that procedure. **Tools 14-4, 14-5, and 14-6** are examples of forms for tracking pollution prevention, calibration, and overall environmental performance indicators, respectively. Similar to the example provided by **Tool 14-3, Procedure for Compliance Assessment**, your facility might want to establish written procedures to which these tracking forms, **Tools 14-4, 14-5, and 14-6**, will be associated.



## TOOLS

### Tool 14-1: Monitoring and Measurement Worksheet

Have we <b>identified operations and activities</b> associated with significant environmental aspects, legal requirements and environmental objectives? If, not how will this be accomplished?	
What type(s) of monitoring and measurement do we need to ensure that <b>operational controls</b> are being implemented correctly?	
What type(s) of monitoring and measurement do we need to ensure that we are <b>complying</b> with <b>applicable legal requirements</b> ?	
What type(s) of monitoring and measurement do we need to ensure that we are <b>achieving</b> our environmental <b>objectives &amp; targets</b> ?	
How do we identify the <b>equipment</b> used for any of the monitoring or measurement listed above?	
How will we ensure that monitoring and measurement equipment is properly <b>calibrated and maintained</b> ?	
What process do we have to periodically <b>evaluate compliance with legal requirements</b> ? How effective is this process?	
<b><i>Our next step on monitoring and measurement is to ...</i></b>	



## Tool 14-2: EMS Program Measurement Criteria Worksheet

Facility Name \_\_\_\_\_

Measurement Elements  EMS Component(s)	Objectives of Component	Activity Measures	Results Indicators	Review Period
Communication Plan				
Stakeholders Input				
Environmental or EMS Training				
Review of Aspects				
Operational Controls				
Environmental Review of New Processes and Activities				
Setting Objectives & Targets				
Environmental Management Program 1				
Environmental Management Program 2				
Documentation				
Regulatory Compliance				
Pollution Prevention				
Other				

Contact person for form:

Date Completed:

## **Tool 14-3: Sample Procedure for a Compliance Assessment**

### **Purpose**

[Your Facility's Name] will conduct periodic compliance assessments to ensure that it complies with all applicable local, state, and federal environmental regulations.

### **Procedure**

1. The Environmental Management Representative (EMR) maintains copies of applicable legal regulations (see Module 4, Form 4-3). Based on these regulations, the EMR and EMS Coordinator compile a list of questions as a compliance assessment protocol. These questions are intended to be sufficient to determine the compliance status of [Your Facility's Name] with respect to applicable environmental regulations (both administrative and performance-related components).
2. The EMS Coordinator and another operations manager carry out the assessment by determining and recording the answers to the compliance assessment protocol. When they are done with the compliance assessment, they note any actual or potential compliance issues on Form 14-3: Compliance Tracking Log. Each actual and potential compliance issue is immediately referred to corrective action.

### **Frequency**

Monthly.

### **Records**

Compliance assessment results are recorded by the EMS Coordinator using Form, 14-3. Records are maintained by the EMS Coordinator.

**Form 14-3: Sample Form for Compliance Tracking Log**

Person Responsible	Regulation	Root Cause	Compliance Check Date	Results	Corrective Action/Date (see: TCA-01)	Compliance Verified/Date

**Tool 14-4: Pollution Prevention Tracking Log**

Area of Company	Pollution Prevention Activity	Date Started	Results	Measurement Method	Person Responsible

Contact:

Date Completed:

### Tool 14-5: Calibration Log

Indicator	Measurement Method	Equipment Used	Equipment calibrated: date/method
Contact Person:		Date Completed:	

### Tool 14-6: Environmental Performance Indicators Log

Aspect	Objective	Indicator	Date Checked	Who Checked	Result	Corrective Action
Contact Person:				Date Completed:		



## EXAMPLES

### Example 14-1: Example of Links Between Aspects, Objectives and Targets, Operational Controls, and Monitoring and Measurement

Significant Aspect	Objective	Target	Operational Control	Monitoring and Measurement
Anti corrosive paint X	C-Maintain compliance	Ongoing	<ul style="list-style-type: none"> <li>• Coating and thinning NESHAP procedure</li> <li>• Paint application work instruction (WI)</li> <li>• Bulk storage WI and containment WI</li> </ul>	<ul style="list-style-type: none"> <li>• Compliance audit</li> <li>• Regulatory reporting</li> <li>• EMS audits</li> </ul>
Non-abated emission of VOCs	I-Reduce VOC emissions	10% by January 2002	<ul style="list-style-type: none"> <li>• VOC - reduction EMP</li> </ul>	<ul style="list-style-type: none"> <li>• VOC volume reduction tracking metric</li> <li>• EMS audits</li> </ul>
Solid waste from unmasking process	S-Investigate potential for reduction	Complete study by January 2002	<ul style="list-style-type: none"> <li>• Solid waste reduction EMP</li> </ul>	<ul style="list-style-type: none"> <li>• Waste reduction tracking metric</li> <li>• EMS audits</li> </ul>

### Example 14-2: Linking Operational Controls and Monitoring

<u>Operation with Significant Environmental Aspect</u>	<u>Operational Controls</u>	<u>Key Characteristics of Operation or Activity</u>	<u>Monitoring or Measurement Methods</u>	<u>Equipment Calibration Needs</u>
<b>Surface Coating Operation</b>  (SEA is VOC emissions)	<ul style="list-style-type: none"> <li>Approved list of coatings →</li> <li>Coating work instruction →</li> <li>Permit report procedure →</li> </ul>	<ul style="list-style-type: none"> <li>Type of coating →</li> <li>Rate of application →</li> <li>Frequency of application →</li> <li>Emissions of VOCs →</li> </ul>	<ul style="list-style-type: none"> <li>Compare to approved list →</li> <li>Measure quantity applied →</li> <li>Use coating log book →</li> <li>Calculate based on use →</li> </ul>	<ul style="list-style-type: none"> <li>None</li> <li>Flow meter</li> <li>None</li> <li>Flow meter</li> </ul>
<b>Liquid Waste Storage</b>  (SEA is potential for spills)	<ul style="list-style-type: none"> <li>Generator procedure →</li> <li>Storage area procedure →</li> </ul>	<ul style="list-style-type: none"> <li>Use of proper containers →</li> <li>Segregation of incompatibles →</li> <li>Availability of spill equipment →</li> </ul>	<ul style="list-style-type: none"> <li>Inspections of storage area →</li> <li>Inspections of storage area →</li> <li>Inspections of storage area →</li> </ul>	<ul style="list-style-type: none"> <li>None</li> <li>None</li> <li>None</li> </ul>